Findhorn Ecovillage
Carbon Assessment 2018

Planet under pressure
Photo: G.Wiklund

Introduction

An assessment of Findhorn Ecovillage's carbon emissions has been done for 2018 using the web-based calculation tool Our Impacts. Ecometrica, the Edinburgh based software company, has kindly sponsored the use of Our Impacts. Previous assessments were done in 2015 and 2017.

A web-based survey was introduced this year to gather data for 2018 from individuals and businesses at the Park and Cluny. The link was emailed out. While respondents were asked to give us their email addresses to be sent confirmation that their response was received to ensure anonymity, the email addresses were erased after the deadline.

Many people have participated in the data collection and reporting. Special mention goes to Bert Meyer, Amanda Haworth, Roger Doudna, Gabrielle Buist, Peter Balderstone, Jürgen Muthmann, and Sverre Koxvold.

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Göran Wiklund

Summary

The total greenhouses gas emissions have been calculated to **3,932 tCO2e** (tonne CO2 equivalent) a reduction of 25% compared with 2017. The highest source of emissions is from flying with **2,829 tCO2**. Vehicles produce the second largest amount of emissions, and accounts for **480 tCO2**.

There are many reasons for the reduction on previous years but a major one is the fact that the number of guests on the Findhorn Foundation (FF) programmes fell by 34%.

Direct and indirect energy emissions (Scope 1 and Scope 2) account for **466 tCO2e** (926 tCO2e). Scope 3 emissions are **3,466 tCO2e** (4,308 tCO2e), which include FF programmes and Findhorn Bay Holiday Park (FBHP) guest travel.

Total emissions in relation to the number of household members of the ecovillage average **8.3 tCO2e** per person, a drop from 13.7 in 2017.

It is difficult to make comparisons between the years as more emission sources have been added and data collection has improved. On the other

hand, some data has not been available for 2018. In addition, some of the models for calculating guest travel contain uncertainty, which to some extent is handled by the fact that the same models were used in 2017 as 2018.

Methodology

The focus has been on calculating the most substantial emissions.

The assessment is done according to the international standard Greenhouse Gas (GHG) Protocol. The Protocol requires measurement of seven potent greenhouse gases. As the gases have different GWP (global warming potential - methane for instance has 25 times higher GWP than CO2) all gases are converted to carbon dioxide equivalents or CO2e.

The GHG Protocol differentiates between three Scopes:

- Scope 1: direct emissions from burning fossil fuel (petrol, gas, wood etc.)
- Scope 2: indirect energy (purchased electricity)
- Scope 3: other indirect emissions (travel, food, consumption etc.)

Air travel has been calculated using an RFI factor 2.0 (Radiative Forcing Index). RFI factor means that air travel at high altitude causes greater emissions than the fossil content of the fuel. Factor 2.0 means a doubling of the fuel content emissions.

Upstream emissions have been added for the emissions where such data is available. That means emissions from, for instance, petrol and gas, as also emissions from production and distribution are calculated. For purchased electricity both upstream emissions and T&D losses (Transmission and Distribution losses) are included.

The emissions have been sourced from four organisational units:

- The Park including co-workers
- Cluny including co-workers
- Titleholders/Park residents
- Businesses with an office &/or operations at the Park

Newbold, Cullerne, Erraid are not included. NFA members who are not registered either as residents of the Park or co-workers are not included in the assessment.

In some cases, data collection is based on estimates or on approximation models. In those categories where the response rate was relatively low

estimations were made to get 100% assuming the emission pattern was similar to those who had responded.

For guests on different programmes and guests at the FBHP models have been designed with qualified assumptions regarding travel, since there is no available information about modes of travel and, for FBHP guests, where they come from. It should be mentioned that the emissions data contains uncertainty as the input data is based on estimates.

Energy emissions are shown on an aggregated Findhorn Ecovillage level and are not calculated for each organisational unit.

Electricity has been calculated using what are called 'market based' emissions factors, which means using emission data from a renewable energy source, in this case the Findhorn Wind Park.

Results

Total emissions

The measured emissions are **3,932 tCO2e**. That is a reduction of 25 % compared with 2017 when the total was **5,235 tCO2e**.

Table 1. Total emissions

The reduction is to the largest part explained by the drop in programme guests for 2018. On the other hand, more emission sources are included, and more comprehensive data collection has resulted in an increase in reported emissions.

Greenhouse gasses

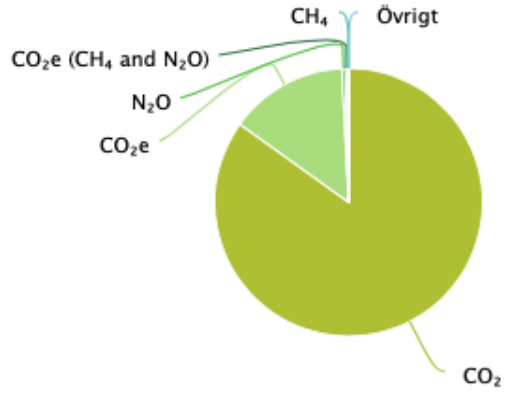

Table 2. Greenhouse gasses

CO_2 represents the largest emission. N_20 the second largest.

Emissions divided by scope

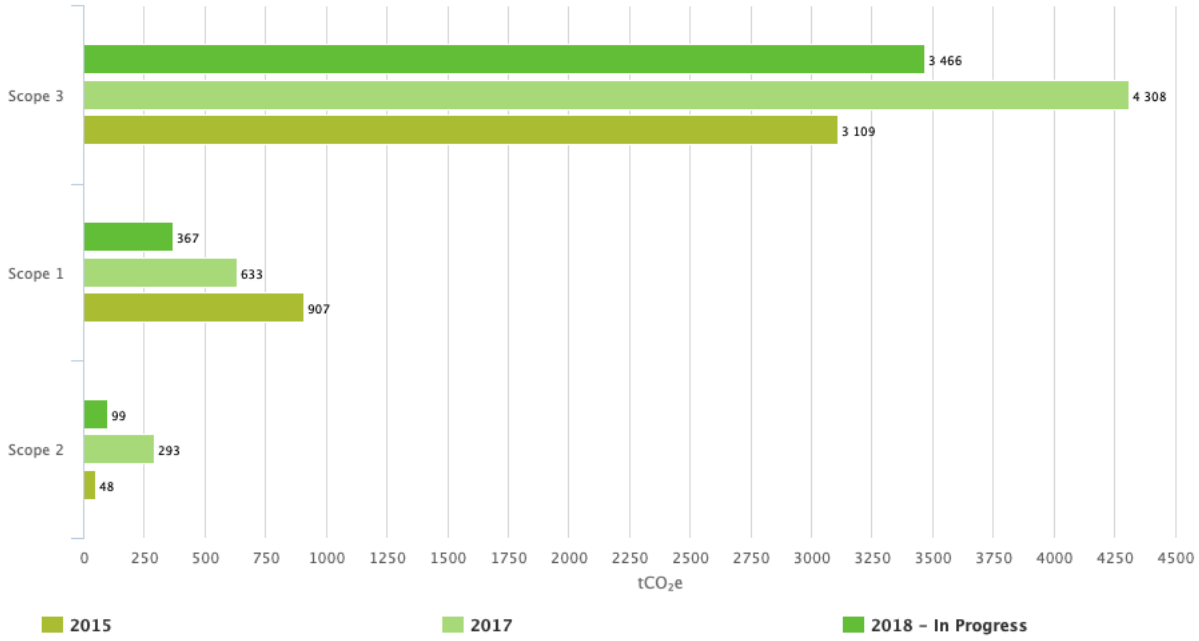

Table 3. Emissions divided by scope

Scope 3, indirect emissions, is the largest at **3,466 tCO2e**, or 82%.
Scope 2, purchased energy (electricity from the wind park and the grid), is **99 tCOe2** (293 tCO2e). The reduction is due to the use of a market-based methodology, which explains a reduction of **268 tCO2**. N.B. this is a methodological and not a real reduction.

Scope 1 emissions (emissions directly from burning fossil fuel, gas and fuel wood) are **367 tCO2e** (633 tCO2e). The reason for the reduction is that car travel was reduced for both residents and guests on programmes.

Emissions divided by emission source

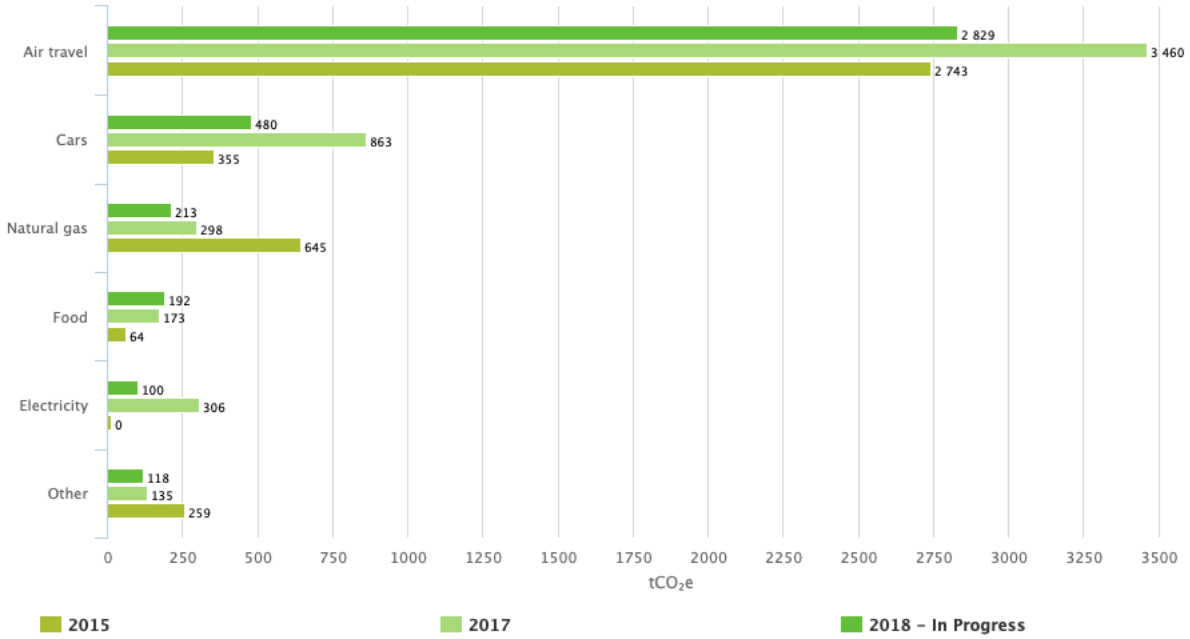

Table 4. Emissions divided by emission source. The diagram shows the highest emissions.

Most of the emissions are a result of air travel by co-workers, residents and guests, **2,829 tCO2** (3,460tCO2e), down by 18%.

One reason for the decrease in travel is the fact that the number of guests participating in programmes fell from 2,976 to 1,976, i.e. by 34 %. At the same time a more accurate estimation was made for FBHP guests as many of them travel by air, which was not assumed for 2107.

Flying

Since air travel is the largest source of emissions a closer analysis has been made.

Category	Short haul, number of flights	Medium haul, number of flights	Long haul, number of flights	Total emission, tCO2
Co-workers	240 (259)	60 (144)	28 (62)	85 (147)
THA/Residents	417 (555)	134 (124)	107 (171)	226 (300)
Findhorn businesses	0 (6)	6 (0)	11 (2)	14 (4)
Guests	2,534 (2,417)	702 (1,063)	1,154 (795)	1,966 (2,940)
Holiday park guests		832(141)	287 (0)	538 (58)
				2,829 (3,460)

Table 5. Air travel divided by distance

Air travel is divided into three distance categories. Emissions per passenger-kilometre differ in each category. One reason is that flying at high altitudes results in greater emissions caused by the vapour trails. Another is that take-offs cause relatively more emissions per distance than cruising. This is why flying is divided into short trips: up to 785 kms (within the UK) or about 2 hours in the air; medium trips: from 785 km to 3,700 kms or 2-4 hours (within Europe), and long trips over 4 hours (outside Europe).

It is assumed that all flying is done in economy class, which results in less emissions per passenger-km than business or first class, as it occupies less space.

Emissions from all reported air travel amounts to **2,829** tCO2e (3,460), down by 18%.

The total number of guests was **1,966** (2,940). This is a 34% reduction from 2017. Guests are coming from 52 countries, of which 33% were travelling from Great Britain, 12% from USA and 9% from Germany. The distribution among countries is relatively even between the years.

Air emissions from all guests were **2,504** tCO2e**, 1,966** tCO2e **(**2,940**)** from programme guests and **538** tCO2e (58) from FBHP customers. Emissions from residents, co-workers and business employees were **325** tCO2e

(451**)**. For the FBHP there is no data for whence guests come or how they travel here. In the past, the approximation model that was used underestimated the number of guests who fly in from the UK and other places, hence the increase in reported emissions this year.

Emissions from residents, co-workers and business staff are relatively even over the two years while emissions from guests vary very much depending on the numbers.

Energy

Emissions from different energy sources amounts to **499 tCO2e**.

Emissions from different energy sources

Source	2018	2017
Gas	213	298
Electricity grid	76	162
Electricity wind	24	14
Fuel Oil	13	1
Fuel wood/pellets/chips	51	25
Total energy emissions	377	500

Table 5. Energy distributed over sources

After travel the second biggest source of emissions is gas. It is used at Cluny and in most households at the Park for heating and cooking. Gas is the largest cause of GHG emissions at **213** tCO2e (298). There is no clear explanation for the difference between years. It could be that purchases from other suppliers than NFD are not correctly reported for 2018, or that the estimate for the ones not responding underestimates their gas consumption.

The Findhorn Wind Park produces energy for local use at the Park and exports its excess to the grid. There is also an import from the grid when the wind isn't blowing. Emissions from wind power were **24** tCO2e (14). The reason for the relatively low figure for 2017 is due to the fact that wind-power production was reduced for several months. Wind power in itself does not emit any carbon but the emission factor is based on a life cycle perspective, which includes building and dismantling the turbines. This is the case for other energy sources as well.

Electricity from the grid emitted 76 tCO2e, and since there is no **certificate of origin** showing it is renewable it has a relatively high emissions factor, whereas wind-power has a low emissions factor.

Fuel oil is **13** tCO2e. The lower number for 2017 depends probably on incorrect data for that year.

The Park wood-chip boiler provides heating for the Universal Hall, the Park Building, the Community Centre and seven bungalows. Soillse has its own wood pellet boiler. Many households rely on wood burning stoves for heat. There is a local production of fuel wood by Kajedo Wanderer who provides about 27 tonnes of firewood for Park users.

Fuels from wood: firewood, pellets and chips emit **51** tCO2e (25). The lower figure for 2017 is due to incomplete data.

Solar energy

Residents and co-workers were asked if they have PV and hot water (thermal) solar collectors. An estimate was made from data provided by respondents: 93 PV and 68 thermal collectors.

Based on average efficiency the collectors produce about 96 MWh. This means that the same quantity of energy does not need to be bought. Had it been bought from the grid when the wind park was not producing excess capacity, the emissions from the imported grid electricity would have been approximately 27 tCO2e. One can argue that these emissions are avoided by using solar energy.

Food

The figure for emissions from food, **192** tCO2e (173), is based on two meals per day served to guests and co-workers in the Community Centre and at Cluny. Most titleholders do their own cooking but there is no data for that. The figure is also a slight underestimation as breakfasts are not included. On the other hand, the emission factor used does not take into account the fact that vegetables are locally sourced during the growing season.

Calculations are based on the assumption that only vegetarian food is served.

Since there were more guests in 2017, the relatively lower number for meals this year depends on a data error for guests served meals at the Park.

Intensity emissions

The survey asked for size of household, and that data be reported for all household members. This means that children and tenants are included. The average size of a household is 1.9 individuals. Households of more than one person are mostly located at the Park. The total number of individuals living in the Park and at Cluny is 476. The number is an estimate and may exceed reality if the non-respondents typically represent small households.

When the total emissions of **3,932** tCO2e are divided by the number of individuals the emissions per capita are **8.3** tCO2e (13.7). The lower number for 2018 is due to the fact that the household size is used, not simply the number of residents and co-workers.

Running an ecovillage with international and national guests coming from far and wide in large numbers causes high emissions. There were **1,976** guests on programmes, and **5,744** FBHP customers.
For 2018 the guest emissions were approximately **2,850 tCO2e**, which means 67% of the total.

It is difficult to reduce travel emissions without also reducing business income.
The hope is that participants on programmes will change their lifestyle to low carbon consumption when they come here. Emissions from guests on programmes amounted to **2,074 tCO2e**, which means about 1 tCO2e per capita.

On average, if each individual reduces his/her emissions by more than 1 tCO2e per annum it becomes a positive carbon trade-off to have guests coming to the Findhorn Foundation and College.

For FBHP customers, however, it is difficult to assume such an effect on lifestyles.

Data quality

The survey was directed towards residents and co-workers on the one hand and to businesses in the Park on the other. The response rate for

residents was 61.6%, while for co-workers it was 23.2%. These response rates are similar to those from last year.
Based on the responses an estimate was made to cover 100% of the residents and co-workers, assuming that non-responders have the same emission pattern. As the response rate for co-workers is unfortunately very low, it makes the estimate for all co-workers most uncertain. There are probably several explanations as to why certain individuals did not respond, such as too short notice, lack of time or not being interested in responding.

For business the survey was directed towards businesses with their office/operations in the Park. 18 businesses were invited to respond and eight did so.

No attempt has been made to count the number of B&B guests in the Park. One reason is that many of them come to attend FF programmes and are therefore already covered when it comes to travel and food. Furthermore, the emissions they cause through their stay are included in the B&B households. Emissions that are no calculated are thus those from B&B guests not participating in any programme.

For next year all co-workers, residents and businesses should be encouraged to participate in the survey in order to reduce the uncertainty in the estimates.

Carbon storage and avoided emissions

The Findhorn Ecovillage is situated on sand dunes. Over the years organic material has been added to create a layer of soil suitable for plants. When organic material accumulates year after year the top layer binds carbon. Organic gardening in particular has the capacity to build up the organic content of the soil, especially when green material is not removed after harvesting, by adding compost and by not ploughing or digging. It is impossible to assess the carbon that has been stored in the soil at the ecovillage without taking samples, but normally 1 hectare (an area 100 m x 100 m), which is similar to the garden at Cullerne), can store 1 tonne of carbon per year, which means drawing down **3.6** tCO2 annually from the atmosphere.

In the survey households were asked if they make compost, and 95% answered in the affirmative. Composting has become easier with the new composting centre started by Evelyn Rodenburg, which is available for all to use.

Planting trees is another way to store carbon. During 2018 4-500 trees were planted in Wilkie's woods. As they grow they will store carbon. This will be released into the atmosphere if they are subsequently used as firewood, but then new trees should be planted. Carbon storage in wood should be seen at a forestry level, i.e. a forest that is kept over time, where single trees are removed and new planted. One hectare of forest can draw down **3** tCO2 from the atmosphere per year.

Tree planting by Trees for Life (TfL) stores carbon. However, after discussions with TfL we cannot include their trees as part of the carbon storage for this survey because TfL commissions its tree planting to corporations for carbon offsetting. This is based on the annual growth, and can only be counted once.

Another carbon sink is building materiel and furniture made from wood. The carbon is locked in even though the tree is cut down.

Carbon offsetting

Carbon offsetting is one way to take responsibility for emissions that can't be avoided in the short term. However, it is not a way of reducing one's emissions. That can only be achieved by consuming less fossil energy directly or indirectly.

The Park Ecovillage Trust (PET) has set up a carbon offsetting service, which gives individuals opportunities to support projects in developing countries at the same time as offsetting carbon emissions. It is also possible to support tree planting in Scotland.

The total quantity of emissions that have been offset since the service was launched at the end of 2017 is 290 tonnes. 86 individuals have participated in the offsetting, and on average they have offset 3.4 tonnes CO2e each.

Reducing emissions

There are many ways to reduce emissions, both indirect and direct. Indirect is for instance the Carbon Conversations workshops held by Maria Cooper, Marilyn Hamilton's initiative the cChallenge and Kay Lynn Sherman who twice involved participants in the Draw Down concept. The Climate Change and Consciousness conference is another example. These initiatives aim at raising carbon consciousness and also spreading knowledge about how to reduce one's emissions.

Direct steps could be taken both at an Ecovillage and individual level to reduce carbon footprints.

Based on the result of this Carbon Assessment the following steps are suggested at the Ecovillage level:

- Replacing gas with electricity
- Moving to renewable gas through Certificates of Origin
- Reducing the energy requirements by installing superior insulation of buildings
- Investing in a 4th wind turbine
- Using geo-thermal heat pumps

On a personal level:

- Limiting flying by using buses or trains for short trips
- Avoiding stopovers when flying
- Reducing car driving, by using buses or trains
- Car sharing or car pooling
- Using bicycles

Some comparative data to bear in mind

- *In order to halt global temperature increase each individual has an annual carbon budget of about 2.0 tCO2e.*
- *The average UK emissions are 9.8 tCO2e/person, or 13.4 tCO2e/person (incl. all greenhouse gasses)*
- *A return air trip economy class New York-Inverness emits 2.4 tCO2e.*
- *CO2e Emissions per person using various transport means for a return trip from Inverness to London:*
  Bus 63 kgs. Train 107 kgs. Car 413 kgs. Air 376 kgs.

Definitions

Carbon footprint: A measure of how much CO2 emissions are associated with fossil energy use. Carbon footprint can be measured on different levels: for instance, a nation's emissions based on the number of its inhabitants can be broken down to an individual footprint. Likewise, an organisation's footprint can be expressed as a per person emission. CO2 concentration in the atmosphere is considered by the scientific community to be the primary driver of global warming. The Paris

agreement says that the global temperature increase must be kept well below +2°.

Ecological footprint: A measure of how much area of biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. The Ecological Footprint is usually measured in global hectares (gha). Because trade is global, an individual or country's footprint includes land or sea from all over the world. Without further specification, Ecological Footprint generally refers to the Ecological Footprint of consumption.